Group Report

1964-46

H. E. Frachtman

Haystack Pointing System: Planet

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Lincoln Laboratory

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Lexington, Massachusetts

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HAYSTACK POINTING SYSTEM: PLANET

H. E. FRACHTMAN

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ABSTRACT

This report describes the procedure used by the Haystack pointing computer
program for obtaining the celestial coordinates of the planets at any time.

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I.   INTRODUCTION

PLANETRACK is a program in the Haystack Univac 490 pointing system whose output is the celestial coordinates of a selected planet at a given time. The program computes the coordinates by 3rd or 4th difference interpolation in the tables of the apparent right ascension, declination, and radius vector of the planets published in The American Ephemeris. The rates of change of the three quantities are computed by numerical differentiation.

II.   INPUTS TO PROGRAM

A.   Inputs Furnished by Core Memory

The program uses the registers listed in Table I for input information. The year and day are used to select the appropriate entries from the ephemeris. The coordinates of the planet are interpolated for the time which is the sum of the times in CELTIME and DELTATEE.

B.   Inputs Furnished by Magnetic Tape

The tape format of the Ephemerides for the planets, which has been edited and recorded on tape by a 7094 program described in Reference (1), is shown in Fig. 1. Each block of 320 words covers a period of 32 days. The ephemeris for each day requires 10 words. The program does not make use of the semi-diameter, horizontal parallax, or the year-month-day words in the block. The tape must be on Unit 1 (normally Servo B), of the Univac 490.

C.   Inputs Furnished by Typewriter

During the operation of the initialization section of PLANETRACK an identification number representing the selected planet must be entered via the typewriter.

III.   PROGRAM OUTPUTS

A.   Outputs Left in Core Memory

The apparent celestial coordinates of the planet, corresponding to the time in the register CELTIME, together with their numerical derivatives, are stored in the appropriate registers, as illustrated in Table II.

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Register	Contents and Scaling
W(CELTIME)	Days B28
W(DELTATEE)	Days B28
U(YEARMONTH)	Year B15 (4 decimal digits)
L(YEARMONTH)	Month B0
L(DAY)	Day of Year B0

TABLE I

Core Memory Inputs to PLANETRACK Program

Note: Notation "B28 means that the
binary point is to the right of bit 28.

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I. D. (Planet number)	Conventional Day Number		

14 ... 0

All Zero	Year	Month	Day

14 ... 8 ... 4 ... 0

Right Ascension	B26	Radians

First Difference Right Ascension	B26	Radians

Declination	B26	Radians

First Difference Declination	B26	Radians

Radius Vector	B24	Astronomical Units

First Difference Radius Vector	B24	Astronomical Units

Semi-Diameter	B26	Radians

Horizontal Parallax	B26	Radians

Fig. 1 Magnetic Tape Format for Planet Ephemeris

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Register	Contents and Scaling
W(RA)	Apparent Right Ascension B27 in revolutions
W(DEC)	Apparent Declination B27 in revolutions
W(RADIUS)	One's Complement Distance from center of Earth to Surface of Planet B24 in Astronomical units
W(RADOT)	Numerical Derivative of Right Ascension B37 radians/sec.
W(DEDOT)	Numerical Derivative of Declination B37 radians/sec.
W(RADIUSDOT)	Numerical Derivative of Radius Vector B24 nautical miles/sec.

TABLE II

Core Memory Outputs of PLANETRACK Program

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B.   Typewriter Outputs

When the PLANETRACK program is initially called, it will use the INTERCOM subroutine to request from the operator the name of the planet whose coordinates are required.   The typewriter will print the names of the planets, (except Earth and Pluto) each followed by the identification number in parenthesis.

During initialization the PLANETRACK program will type, using the INTERCOM subroutine, certain information concerning the selected planet.   Items printed are:

1.   Julian Day corresponding to values in YEARMONTH, DAY, and CELTIME (7 digits).

2.   Apparent Right Ascension of planet (Hours, Minutes, Seconds to hundredths).

3.   Apparent Declination of planet (Degrees, Minutes, Seconds to hundredths).

4.   Day of Year corresponding to values in YEARMONTH and DAY (up to 3 digits).

5.   Universal Time for which the coordinates are interpolated.   It is the time in CELTIME at initialization (Hours, Minutes, Seconds to hundredths).

6.   The distance between the centers of the Earth and planet (Astronomical Units to hundred millionths).

7.   The name of the planet.

If, after a search through 8 files on Unit 1 (or the finding of an end of tape mark), the planet ephemerides are not found, the program will type "(W) EPHEMERIS FOR X/Y NOT AMONG FIRST 8 FILES" and will exit to the master control program error return.   "W" is the number specifying the selected planet, "X" and "Y" indicate the current month and year, respectively.

If there is a tape servo malfunction during search, the program will type "1IIC STATUS S1 ZZ" and will exit to the master control program error return.   The two digit octal number "ZZ" comes from the tape status word and indicates the error condition.

IV.   ASTRONOMICAL SIGNIFICANCE

The apparent right ascension and declination of the planet in the emphemerides are referred to the true equinox and equator of date and are corrected for planetary aberration.   They are geocentric apparent quantities; the parallax correction is made by the coordinate conversion program (COCON) in the Haystack system.   The values

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in the tables are computed for Ephemeris Time as argument. The equation

$$ET = UT + \Delta T$$

is used to convert from Universal Time to Ephemeris Time. The constant ΔT, represented by the number in the register DELTATEE is approximately 35 seconds.

The radius vector is the actual geometric distance in astronomical units between the centers of the Earth and planet at the stated time.

The number 934.91 is used to convert astronomical units per day to nautical miles per second in the computation of the number in RADIUSDOT.

$$934.91 = \frac{499.005 \times 2.997925 \times 10^5}{1.852 \times 86400}$$

499.005 = number of seconds per astronomical unit

2.997925×10^5 = velocity of light in kilometers per second

1.852 = kilometers per nautical mile

86400 = seconds per day

A comprehensive explanation of the ephemerides is given in Reference (2).

V. PROGRAM DETAILS

The PLANETRACK program is a subroutine of the Haystack Univac 490 pointing program. The initialization section begins at PLANETINIT, the working section at PLANETCONT. There are several closed subroutines within PLANETRACK. These are: DAYFIND, STATUSCK, INTERPOL, LEFRNDOFF, and ROUNDOFF. A listing of the program is given in Appendix I.

A. Initialization

The program, upon initialization, stores an RIL instruction in the tape channel internal interrupt register and an RJP STATUSCK instruction in the external interrupt register. The area in core into which the tape data will be read is cleared, together with some additional registers. This is done to make diagnosis easier in case of malfunction.

The planet ephemeris entries are serially numbered by the program which generates the magnetic tape (Reference 1). These serial numbers are called "Conventional

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Day Numbers" (CDN). An arbitrary decision was made to produce and use tapes such that the CDN for 25 April 1963 is zero. The tape search process looks at the first word in each block, therefore, the PLANETRACK program must con pute the CDN of the first word of the block containing the entry for the required day.

Using as inputs the year, day of year, and the effect of integral and half-integral values of CELTIME, the program computes the Julian Day number for the typewriter. The ephemerides start and run continuously from 25 April 1963, which has a Julian Day Number of 2438144.5; this number is subtracted from the computed Julian Day number and appears on tape as the Conventional Day Number. (it is 6 for 1 May 1963, the first day for which ephemerides tapes were made for the system.)

The first CDN in each block will be given by $6 + 32n$ where n is a positive integer or zero. If the first CDN of each record does not belong to this series, the tape search will be unsuccessful. The first CDN in a block is stored in TAPEBLOCK (lower half) and the planet identification number is added to generate a tape search comparison word, stored in TAPESEARCH and also in SAFE.

The number in SLOTBLOCK represents the number of the entry in the 32-word block.

If $2 < \text{SLOTBLOCK} \leq 28$, only one block need be read in; if not, either the preceding or following tape block should also be read to provide sufficient ephemerides for 4th difference Bessel interpolation for a four-day period.

If the one-or two-block search and read operations are successful, control is regained at NORMAL and the tape is rewound without interrupt or interlock, At this time, planet ephemerides for either 32 or 64 days are in core memory.

The program performs 4th difference interpolation for Mercury and Venus and third difference interpolation for the other planets.

Besselian interpolation of right ascension is done by the INTERPOL subroutine and the interpolated result is converted to hours, minutes, and seconds and stored for type out. Declination and distance are then interpolated and stored for type out. The other quantities which are to be typed out by INTERCOM are set up. Control is transferred to INTERCOM 7 times for the seven line type out, which completes operation of the initialization section of PLANETRACK.

B.   Working Section

The PLANETRACK working section begins at PLANETCONT.   Control is trans-
ferred to the subroutine DAYFIND which selects the day's ephemeris entry, stores
the addresses of the table entries, and computes the interpolation argument P from
the given value of CELTIME.   The INTERPOL subroutine is then entered three times
for the interpolation of right ascension, declination, radius and their time rates.
An amount corresponding to the radius of the planet is subtracted from the interpo-
lated value for accurate radar range control.   All values are converted, scaled and
stored properly in core memory and control is transferred to the master control
program.

C.   Subroutines

The initialization section of the PLANETRACK program makes use of the INTER-
POL, DAYFIND, STATUSCK, LEFRNDOFF, and ROUNDOFF subroutines.   The
working section uses all except STATUSCK.

1.   INTERPOL

The PLANETRACK interpolation subroutine uses Bessel's interpolation formula
(Reference 3) for 3rd or 4th difference interpolation of the ephemeris.   The formula
is

$$f_p = f_o + P\delta f_{1/2} + \frac{P(P-1)}{4} [\delta^2 f_o + \delta^2 f_1]$$

$$+ \frac{P(P-1)\,(P-1/2)}{6} \delta^3 f_{1/2} + \frac{(P+1)\,P(P-1)\,(P-2)}{48} (\delta^4 f_o + \delta^4 f_1)$$

The quantities in the formula are associated with computer registers as follows:

    a.   The address of f_o is in index register 4.

    b.   The interpolation argument P is in register P.

    c. $\delta f_{1/2}$ is in register GAMMA.

    d.   P(P-1) is in register PSQMP.

    e. $\delta^2 f_o + \delta^2 f_1$ is in register DMINB.

    f. $\frac{P(P-1)}{6}$ is in register PSQMP6.

    g. $\delta^3 f_{1/2}$ is in register DMIN2CPLB.

    h. $(\delta^4 f_o + \delta^4 f_o)$ is in register EP2BM2DMA.

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i. f_p is in the A register at the finish.

The subroutine also performs numerical differentiation using the following formula (Reference 3):

$$hf'_p = \delta f_{1/2} + \frac{2P-1}{4} [\delta^2 f_o + \delta^2 f_1]$$
$$+ \frac{3P^2 - 3P + 1/2}{6} \delta^3 f_{1/2}$$

At the completion of the subroutine, hf'_p is stored in the register NUMDERIV.

When the subroutine is entered, Index Register 4 contains the address of f_o and the register SETINTAD contains the address of $\delta f_{1/2}$ of the quantity to be interpolated. Index register 3 is used to acquire the other two first difference registers.

2.   DAYFIND

The DAYFIND subroutine computes the Julian Day number and the addresses of the ephemeris entries corresponding to the current day. It also computes the interpolation argument P by properly scaling the sum of CELTIME and DELTATEE. The value of P is always positive, even though time be set negative by the system control programs. The number in DAYINDEX, which can be -2, -1, 0, or +1, takes account of the effect of the integral part of CELTIME on the selection of ephemeris entry.

3.   STATUSCK

The STATUSCK subroutine is entered from the external interrupt register associated with the tape channel when the interrupt occurs. Examination of the status code generates four possible outcomes:

a.   If the code indicates a normal completion, control is returned to the program at the interrupted point.

b.   If the code indicates that an end of tape mark was sensed, the tape is rewound and a message indicating failure to find the ephemeris is printed by the typewriter. The message is described in Section IIIB. Control is passed to the error return of the master control program.

c.   If the code indicates that an end of file mark was sensed, the register IMPERIAL is indexed and tested for the value 8. When less than 8 the next file

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is searched by passing control to TRYAGAIN. When IMPERIAL equals 8, an end of tape condition is assumed and the action is as described in (b) above.

d. If the code indicates anything but end of file, end of tape, or normal completion, a tape error has occurred. The message described in Section IIIB, indicating the type of error is printed by the typewriter and control is passed to the error return of the master control program.

4. LEFRNDOFF

The LEFRNDOFF subroutine left shifts the AQ register the number of places indicated by the contents of index register 5 and rounds the A register.

5. ROUNDOFF

The ROUNDOFF subroutine right shifts the AQ register the number of places indicated by the contents of index register 5 and rounds the A register.

SPURT OUTPUT NO. 21C

PLANETRACK   FRACHTMAN*8/4/64

NO. OF INSTRUCTIONS   03460
    00000   THRU   01553
    03452   THRU   03457

PLANETRACK FRACHTMAN*8/4/64

CARDS	L1 ID LABEL	TA	STATEMENT	LOC	F JKB	Y	NOTES
OC000	PLANETRACK	PROGRAM	FRACHTMAN*8/4/64				
OC001	CRUISE	EQUALS	100				
OC002	MONITAPE	EQUALS	55				
OC003	TAPEINPUT	EQUALS	35				
OC004	EPHEM	MEANS	C15*				
OC005	HENRY	U-TAG	PLANETCONT*PLANETINIT				
OC006		FD	1*PLNET				
OC007	PLANETINIT	ENTRY		00000	C0216	C0002	
OC010		ENT	A*W(IGNORE)	00001	25212	31231	
OC011		STR	A*W(MONITAPE)	00002	61000	C000C	
OC012		ENT	A*W(INTERUPT)	00003	11030	C1062	
OC013		STR	A*W(TAPEINPUT)	00004	15030	C0055	
OC014		ENT	B4*975D	00005	11030	C1061	
OC015		CL	A*	00006	15030	C0035	
OC016	ERASE	STR	A*W(IDENT+B4)	00007	12400	C1717	1ST TEMP STCR
OC017		BJP	B4*ERASE	00010	11000	C000C	
OC020		RJP	U(INTERCOM)	00011	15034	C1533	
OC021		U-TAG	BODIES*INPLANET	00012	72400	CC011	LIST OF PLANETS
OC022		ENT	A*W(PLAN)	00013	65020	63426	
OC023		STR	A*U(IDENT)	00014	C0566	01034	
OC024		ENT	A*U(YEARMONTH)	00015	11030	C104C	
OC025		SUB	A*1961D	00016	15020	C1533	
OC026		STR	A*W(MONTHPRINT)	00017	11020	63147	
OC027		RSH	AQ*30D	00020	21000	03651	
OC030		DIV	4	00021	15030	C1C41	
OC031		STR	A*W(YRREMAIN)	00022	C3000	C0036	(0,1,2,3)
OC032		MUL	1461D	00023	23000	CCC04	DAYS IN 4 YRS
OC033		STR	Q*W(WHOLEYEAR)	00024	15030	C1534	
OC034		ENT	Q*W(YRREMAIN)	00025	22000	02665	
OC035		MUL	365D	00026	14030	C1535	
OC036		RPL	Y+Q*W(WHOLEYEAR)	00027	10030	01534	
OC037		RJP	DAYFIND	00030	22000	CC555	
OC040		ENT	Q*W(TAPEBLOCK)	00031	34030	01535	
OC041		LSH	Q*5	00032	65000	C0312	
OC042		ADD	Q*6	00033	10030	C154C	
OC043		ADD	Q*W(IDENT)	00034	C5000	CC005	
OC044		STR	Q*W(SAFE)*SKIP	00035	26000	C0006	
OC045	TRYAGAIN	ENT	Q*W(SAFE)	00036	26030	C1533	
OC046		STR	Q*W(TAPESEARCH)	00037	14130	C1552	
OC047		ENT	Q*28D	00040	14030	01552	
OC050		ENT	A*2	00041	14030	C1542	
OC051		COM	AQ*W(SLOTBLOCK)*YIN	00042	10000	CCC34	
OC052		JP	NOTIN	00043	11000	CCCC2	
OC053	BLOCKBEE	(N	EPHEM*W(EPHEMB)	00044	C4430	C1541	
OC054		NO-OP		00045	61000	CC533	
OC055		EX-FCT	EPHEM*W(SRHIB(N)	00046	73670	CC564	
OC056		NO-OP		00047	12000	CCCCC	
OC057		EX-FCT	EPHEM*W(TAPESEARCH)	0C050	13670	C106C	
OC060		JP	$	0C051	12C00	CCCCC	
OC061	NORMAL	EX-FCT	EPHEM*W(REWINDNO)	00052	13670	C1542	
				00053	61CC0	CCC53	
				00054	13670	C1063	

PLANETRACK   FRACHTMAN*8/4/64

CARDS	L1 IO LABEL	TA STATEMENT	LOC	F JKB Y	NOTES
00062	ENT	B4*L(RAAO)	00055	12410 01543	
00063	ENT	A*L(RADIFAO)	00056	11010 01546	
00064	STR	A*L(SETINTAO)	00057	15010 01131	
00065	RJP	INTERPOL	00060	65000 01152	
00066	ENT	Q*O*ANEG	00061	10700 0000C	
00067	SUB	A*W(TWOPIE)*APOS	00062	21630 01076	
00070	AOD	A*W(TWOPIE)	00063	20030 01076	
00071	RSH	AQ*270	00064	C3000 C0033	
00072	DIV	W(HRAO)	00065	23030 C1065	
00073	STR	Q*W(RA2)	00066	14030 C0671	
00074	CL	Q*	00067	10000 CC00C	
00075	RSH	AQ*230	00070	C3000 00027	
00076	DIV	W(MINSRAD)	00071	23030 01066	
00077	STR	Q*W(RA4)	00072	14030 00674	
00100	RSH	AQ*300	00073	C3000 00036	
00101	MUL	W(SRAO)	00074	22030 C1064	
00102	LSH	AQ*2*QPOS	00075	C7200 C0002	
00103	AOO	A*1	00076	20000 C0001	
00104	STR	A*W(RA6)	00077	15030 C0677	
00105	ENT	B4*L(DECAD)	00100	12410 01544	
00106	ENT	A*L(DECDIFAD)	00101	11010 01547	
00107	STR	A*L(SETINTAD)	00102	15010 01131	
00110	RJP	INTERPOL	00103	65000 01152	
00111	STR	A*W(GMT2)	00104	15030 00757	
00112	ENT	Q*O*APOS	00105	10600 CCCCC	
00113	CP	A*	00106	15040 00000	
00114	RSH	AQ*220	00107	C3000 00026	
00115	DIV	W(MINSRAO)	00110	23030 C1066	
00116	STR	Q*W(OLN2)	00111	14C30 00724	
00117	CL	Q*	00112	10000 0000C	
00120	RSH	AQ*240	00113	C3000 C0030	
00121	DIV	W(SECSRAO)	00114	23030 C1072	
00122	STR	Q*W(OLN4)	00115	14C30 00727	
00123	RSH	AQ*300	00116	C3C00 C0036	
00124	MUL	W(SARAD)	00117	22030 01073	
00125	LSH	AQ*2*QPOS	0012C	C7200 C0002	
00126	AOO	A*1	00121	20000 C0001	
00127	STR	A*W(OLN6)	00122	15030 00732	
00130	ENT	A*W(GMT2)*ANEG	00123	11730 00757	
00131	JP	$+3	00124	61000 C0127	
00132	ENT	A*W(OLN2)	00125	11030 0C724	
00133	STR	A*CPW(OLN2)	00126	15070 00724	
00134	ENT	A*W(CELTIME)	00127	11C30 63133	
00135	ENT	Q*O*APOS	00130	10600 CCCCC	
00136	CP	A*	00131	15040 0000C	
00137	RSH	AQ*260	00132	C3CC0 C0032	
00140	DIV	W(HOAY)	00133	23030 C1C67	
00141	STR	Q*W(GMT2)	00134	14030 00757	
00142	CL	Q*	00135	10000 0000C	
00143	RSH	AQ*230	00136	C3000 CCC27	

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PLANETRACK

CARDS	L1 ID LABEL	TA STATEMENT	LOC	F JKB Y	ACTES
OC144		DIV W(MDAY)	00137	23C30	C107C
OC145		STR Q*W(GMT4)	00140	14030	C0762
OC146		RSH AQ*30D	00141	C3000	C0036
OC147		MUL W(SDAY)	00142	22030	C1071
OC150		LSH AQ*2*QPOS	00143	C7200	CCCC2
OC151		ACD A*1	00144	20000	C0001
OC152		STR A*W(GMT6)	00145	15030	C0765
OC153		ENT A*W(CELTIME)*ANEG	00146	11730	63133
OC154		JP $+3	00147	610C0	0C152
OC155		ENT A*W(GMT2)	0015C	11030	C0757
OC156		STR A*CPW(GMT2)	00151	15070	00757
OC157		ENT B4*L(OISTAD)	00152	12410	C1545
OC160		ENT A*L(OISTOIFAD)	00153	11C10	C155C
OC161		STR A*L(SETINTAD)	00154	15010	C1131
OC162		RJP INTERPOL	00155	65C00	C1152
OC163		STR A*W(INITIAL18)	00156	15C30	C1CCC
OC164		ENT A*W(JULIANDAY)	00157	11C30	C1536
OC165		STR A*W(INITIAL3)	0016C	15030	C0635
OC166		ENT A*L(OAY)	00161	11C10	6315C
OC167		STR A*W(INITIAL12)	00162	15C30	C0646
OC170		ENT A*U(IDENT)	00163	11020	01533
OC171		LSH A*1	00164	C6C00	C0001
OC172		SUB A*2	00165	21C00	C0CC2
OC173		STR A*L(SAIGON)	00166	15C10	C1551
OC174		ENT B4*L(SAIGON)	00167	12410	C1551
OC175		CL B5*	00170	12500	C0CCC
OC176	SETBODY	ENT A*W(MERCURY+B4)	00171	11034	C1014
OC177		STR A*W(INITIAL21+B5)	00172	15035	01011
OC200		BSK B4*777	00173	71400	00777
OC201		BSK B5*1	00174	71500	CC001
OC202		JP SETBODY	00175	610C0	CC171
OC203		RJP U(INTERCOM)	00176	65C20	63426
OC204		U-TAG INITIALJD*0	00177	C0625	0000C
OC205		RJP U(INTERCOM)	0020C	65C20	63426
OC206		U-TAG RGHTASC*0	00201	C0647	CCCCC
OC207		RJP U(INTERCOM)	U0202	65C20	63426
OC210		U-TAG DLN*0	00203	C0702	C0CCC
OC211		RJP U(INTERCOM)	00204	65C20	63426
OC212		U-TAG INITIALDAT*0	00205	CC636	C0CCC
OC213		RJP U(INTERCOM)	00206	65C20	63426
OC214		U-TAG GMT*0	002U7	C0735	C0CCC
OC215		RJP U(INTERCOM)	0021C	65C20	63426
OC216		U-TAG INITIALDIS*0	00211	C0770	C0CCC
OC217		RJP U(INTERCOM)	00212	65C20	63426
OC220		U-TAG INITIALROD*0	00213	C1001	CCCCC
OC221	AIRPORT	RPL Y+1*L(PLANETINIT)	00214	36010	C0CC2
OC222		JP A	00215	61C70	CCCCC
OC223	PLANETCONT	ENTRY	00216	61C00	C0216
OC224		RPL Y+1*L(PLANETCONT)	00217	36010	C0216
OC225		RJP DAYFIND	0022C	65C00	C0312

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PLANETRACK

CARDS	L1 ID LABEL	TA STATEMENT		LCC	F JKR Y		NOTES
00226		ENT	B4*L(RAAD)	00221	12410	C1543	
00227		ENT	A*L(RADIFAD)	00222	11010	C1546	
00230		STR	A*L(SETINTAD)	00223	15010	C1131	
00231		RJP	INTERPOL	00224	65000	C1152	
00232		RSH	AQ*300	00225	C3000	C0036	
00233		MUL	W(REVSRADIAN)	00226	22030	C1057	
00234		JP	MOOSE=QPOS	00227	60200	CC231	
00235		ADD	A*1	0023C	20000	CCCC1	
00236	MOOSE	STR	A*W(RA)	00231	15030	63002	
00237		ENT	Q*W(NUMQERIV)	00232	10030	C1137	
00240		MUL	W(RORSEC)	00233	22030	C1C74	
00241		ENT	B5*4	00234	12500	CCCC4	
00242		RJP	ROUNDOFF	00235	65000	C1512	
00243		STR	A*W(RADDT)	00236	15030	63CC7	B37 RADS/SEC
00244		ENT	B4*L(OECAD)	00237	12410	C1544	
00245		ENT	A*L(OECDIFAD)	00240	11010	C1547	
00246		STR	A*L(SETINTAD)	00241	15010	C1131	
00247		RJP	INTERPOL	00242	65000	C1152	
00250		RSH	AQ*300	00243	C3000	C0036	
00251		MUL	W(REVSRADIAN)	00244	22030	C1057	
00252		JP	NEGQEC*ANEG	00245	60700	C053C	
00253		JP	BEAVER*QPOS	00246	60200	C025C	
00254		ADD	A*1	00247	20000	CCCC1	
00255	BEAVER	STR	A*W(OEC)	0025C	15030	63CC3	
00256		ENT	Q*W(NUMQERIV)	00251	10030	C1137	
00257		MUL	W(RORSEC)	00252	22030	C1C74	
00260		ENT	B5*4	00253	12500	CCCC4	
00261		RJP	ROUNDOFF	00254	65000	C1512	
00262		STR	A*W(DECDOT)	00255	15030	63C1C	B37 RADS/SEC
00263		ENT	B4*L(OISTAD)	00256	12410	C1545	
00264		ENT	A*L(OISTDIFAD)	00257	11010	C155C	
00265		STR	A*L(SETINTAD)	00260	15010	C1131	
00266		RJP	INTERPOL	00261	65000	C1152	
00267		ENT	B5*U(IDENT)	00262	12520	C1533	
00270		SUB	A*W(PLANRAD+B5)	00263	21035	C1522	
00271		CP	A*	00264	15040	CCCCC	
00272		STR	A*W(RADIUS)	00265	15030	63C06	
00273		ENT	Q*W(NUMQERIV)	00266	10030	C1137	
00274		MUL	W(AUDNMSEC)	00267	22030	C1C56	
00275		ENT	B5*110	00270	12500	CCC13	
00276		RJP	LEFRNDOFF	00271	65000	C1502	
00277		STR	A*W(RADIUSDOT)	00272	15030	63C11	B24 NM/SEC
00300	SEAPORT	EXIT		00273	61C1C	CC216	
00301	FLATNEG	CP	A*	00274	15C4C	CCCCC	
00302		SUB	A*W(HALFDAY)*APUS	00275	21630	C1C56	
00303		JP	LESSDNE	00276	61C00	CC31C	
00304		RSH	AQ*300	00277	C3C00	CCC36	
00305		DIV	W(HALFDAY)	0030C	23C30	C1C56	
00306		LSH	AQ*300	00301	C7000	CCC36	
00307		SUB	A*1	00302	21C00	CCCC1	

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PLANETRACK   FRACHTMAN*8/4/64

CARDS	L1 ID LABEL	TA STATEMENT	LOC	F JKB Y	NOTES
	0C31C	JP TWOLESS*AZERU	00303	60400 0C306	
	0C311	JP TWOLESS*ANEG	00304	60700 0C3C6	
	0C312	ENT A*-3*SKIP	00305	11140 77774	
	0C313 TWOLESS	ENT A*-2	00306	11040 77775	
	0C314	JP STORE	00307	61000 00352	
	0C315 LESSONE	ENT A*-1	00310	11040 77776	
	0C316	JP STORE	00311	61000 0C352	
	0C317 DAYFINO	ENTRY	00312	61000 CCCCC	
	0C320	ENT A*WICELTIME)	00313	11030 63133	
	00321	ADD A*WIDELTATEE)*APOS	00314	20630 63316	
	0C322	JP NEGTIME	00315	61000 00327	
	0C323	LSH A*1*APOS	00316	C6600 CCCC1	
	0C324	SUB A*WIKEY)*SKIP	00317	21130 0111C	
	0C325	STR A*WIP)*SKIP	00320	15130 C1117	
	0C326	STR A*WIP)*SKIP	00321	15130 C1117	
	0C327	ENT A*0*SKIP	00322	11100 CCCCC	
	0C330	ENT A*1	00323	11000 CCCC1	
	0C331	JP TIMESLIDE	00324	61000 00335	
	0C332 DAYINDEX	0	00325	C0000 CCCCC	
	0C333 DAYINCRMNT	0	00326	C0000 CCCCC	
	0C334 NEGTIME	LSH A*1*APOS	00327	C6600 00001	
	0C335	SUB A*WIKEY)*SKIP	00330	21130 0111C	
	0C336	STR A*WIP)*SKIP	00331	15130 01117	
	0C337	STR A*WIP)*SKIP	00332	15130 01117	
	0C340	ENT A*-2*SKIP	00333	11140 77775	
	0C341	ENT A*-1	00334	11040 77776	
	0C342 TIMESLIOE	STR A*W(DAYINOEX)	00335	15030 C0325	
	0C343	ENT A*WICELTIME)*APOS	00336	11630 63133	
	0C344	JP FLATNEG	00337	61000 C0274	
	0C345	SUB A*WIHALFOAY)*APOS	0034C	21630 C1056	
	0C346	JP LESSONE	00341	61000 C031C	
	0C347	RSH AQ*300	00342	C3000 00036	
	0C350	OIV WIHALFOAY)	00343	23C30 C1056	
	0C351	LSH AQ*300	00344	C7000 C0036	
	0C352	SUB A*1	00345	21000 CCCC1	
	0C353	JP CERO*AZERO	00346	60400 00351	
	0C354	JP CERO*ANEG	00347	60700 C0351	
	0C355	ENT A*1*SKIP	0035C	11100 CCCC1	
	0C356 CERO	ENT A*0	00351	11CC0 CCCCC	
	0C357 STORE	STR A*WIOAYINCRMNT)	00352	15030 C0326	
	0C360	ADC A*WIWHOLEYEAR)	00353	2CC30 C1535	
	0C361	ADD A*24373000	00354	2CC30 C3454	JC DEC 31 196C GNWCH NCCN
	0C362	ADD A*LIDAY)	00355	20C1C 6315C	
	0C363	STR A*WIJULIANOAY)	00356	15C3C C1536	
	0C364	ADD A*W(DAYINOEx)	00357	2CC3C CC325	JC MAY 1 1963 GNWCH NOON
	0C365	SUB A*24381510	0036C	21C3C C3455	
	0C366	SUB A*W(DAYINCRMNT)	00361	21C3C CC326	
	0C367	RSH AQ*300	00362	C3CCC CCC36	
	0C37C	DIV 320	00363	23CC0 CCC4C	

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PLANETRACK

CARDS	L1 IO LABEL	TA STATEMENT	LOC	F JKB	Y	NOTES
00371		STR Q*W(TAPEBLOCK)	00364	14030	0154C	
00372		STR A*W(SLOTBLOCK)	00365	15030	C1541	
00373		ENT Q*W(SLOTBLOCK)	00366	10030	C1541	
00374		MUL 12	00367	22000	00012	
00375		AOO Q*AEPHEM+3220	00370	26000	02255	
00376		STR Q*L(RAAO)	00371	14010	C1543	
00377		AOO Q*1	00372	26000	C0001	
00400		STR Q*L(RAOIFAO)	00373	14010	C1546	
00401		AOO Q*1	00374	26000	C0001	
00402		STR Q*L(OECAO)	00375	14010	C1544	
00403		AOO Q*1	00376	26000	C0001	
00404		STR Q*L(OECDIFAD)	00377	14010	01547	
00405		AOO Q*1	00400	26000	C0001	
00406		STR Q*L(OISTAD)	00401	14010	01545	
00407		AOO Q*1	00402	26000	C0001	
00410		STR Q*L(OISTDIFAD)	00403	14010	0155C	
00411		EXIT	00404	61010	C0312	
00412	STATUSCK	ENTRY	00405	61000	000CC	
00413		STR EPHEM*W(TAPSTAT)	00406	17670	C0525	
00414		ENT A*U(TAPSTAT)	00407	11020	C0525	
00415		RSH A*11D	00410	C2000	00013	
00416		STR A*W(TAPSTAT+1)	00411	15030	00526	
00417		RPL Y+1*L(STATUSCK)	00412	36010	00405	
00420		ENT B3*L(TAPSTAT+1)	00413	12310	C0526	
00421		RIL	00414	60000	0000C	4 SEQ ERR SYNC 20
00422	STATACT	JP STATACT+B3	00415	61003	00416	5 REWINOING 24
00423		JP BUST	00416	61000	00477	6 CHAR COUNT 30
00424		JP BUST	00417	61000	00477	7 ILLEGAL 34
00425		JP BUST	00420	61000	C0477	10 40 NORMAL
00426		JP BUST	00421	61000	C0477	11 REPEAT 44
00427		JP BUST	00422	61000	C0477	12 SEQ ERR CCNT 50
00430		JP BUST	00423	61000	00477	13 ECF 54
00431		JP BUST	00424	61000	C0477	14 EOT 60
00432		JP BUST	00425	61000	C0477	15 NCNSUCH
00433		EXIT	00426	61010	C0405	16 ABN F C 70
00434		JP BUST	00427	61000	00477	17 INTERLOCK 74
00435		JP BUST	00430	61000	00477	
00436		JP ENOFILE	00431	61000	C0473	
00437		JP CANTFINO	00432	61000	C0436	
00440		JP BUST	00433	61000	00477	
00441		JP BUST	00434	61000	CC477	
00442		JP BUST	00435	61000	CC477	
00443	CANTFIND	EX-FCT EPHEM*W(REWINONC)	00436	13670	01C63	
00444		ENT A*U(IOENT)	00437	11020	01533	
00445		AOO A*60	00440	20000	CCC6C	
00446		LSH A*22	00441	C6000	CC022	
00447		ACO A*5100400512	00442	20C30	C3456	
00450		STR A*W(NODATA1)	00443	15030	C0612	
00451		ENT B4*L(MONTHPRINT)	00444	12410	C1041	
00452		ENT A*W(YEARPRINT+B4)	00445	11034	C1C77	

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PLANETRACK

CARDS / LI ID	LABEL	TA	STATEMENT	LCC	F JKB Y	NOTES
00453		STR	A*W(NODATA2)	00446	15C30 CC616	
00454		ENT	B4*L(YEARMONTH)	00447	12410 63147	
00455		ENT	A*W(MONTHPRINT+B4)	00450	11C34 C1C41	
00456		RPL	A+Y*W(NODATA2)	00451	24C30 CC616	
00457		CL	A*	00452	11000 CCCCC	
00460		ENT	Q*L(BARRIER)	00453	1CC10 CC474	
00461		DIV	12	00454	23C00 CC612	
00462		ADD	A*60	00455	20000 C0C6C	
00463		STR	A*U(IMPERIAL)	00456	15C20 C1537	
00464		CL	A*	00457	11000 CCCCC	
00465		DIV	12	00460	23CC0 CCC12	
00466		JP	ALBERT*AZERO	00461	60400 CC463	
00467		ADD	A*60	00462	20000 CCC6C	
00470	ALRERT	LSH	A*6	00463	C6C00 CCCC6	
00471		ADD	A*U(IMPERIAL)	00464	20020 C1537	
00472		LSH	A*6	00465	C6000 CCCC6	
00473		ADD	A*3105000005	00466	2CC30 C3457	
00474		STR	A*W(NODATA3)	00467	15030 CC622	
00475		RJP	U(INTERCOM)	00470	65020 63426	
00476		U-TAG	NODATA*0	00471	C0610 CCCCC	
00477		JP	L(PLANETINIT)	00472	61010 CCCC2	
00500	ENDFILE	RPL	Y+1*L(IMPERIAL)	00473	36010 C1537	
00501	BARRIER	SUB	A*8D	00474	21C00 CCC1C	
00502		JP	CANTFIND*AZERO	00475	60400 CC436	PLANETS
00503		JP	TRYAGAIN	00476	61000 CCC4C	
00504	BUST	EX-FCT	EPHEM*W(REWINDNO)	00477	13670 C1C63	
00505		ENT	A*L(TAPSTAT+1)	00500	11C10 CC526	
00506		RSH	A*1	00501	C2000 CCCC1	
00507		ADD	A*60	00502	20C00 CCC6C	
00510		LSH	A*6	00503	C6000 CCCC6	
00511		STR	A*L(TAPSTAT+2)	00504	15C10 CC527	
00512		ENT	A*L(TAPSTAT+1)	00505	11010 CC526	
00513		SEL	CL*X77776	00506	52040 77776	
00514		LSH	A*2	00507	C6CC0 CCCC2	
00515		ADD	A*60	00510	2CC00 CCC6C	
00516		ADD	A*L(TAPSTAT+2)	00511	20C10 CC527	
00517		STR	A*L(TAPEBUST1+3)	00512	15C1C CC523	
00520		RJP	U(INTERCOM)	00513	65C20 63426	
00521		U-TAG	TAPEBUST*0	00514	CC516 CCCCC	
00522		JP	L(PLANETINIT)	00515	61010 CCCC2	
00523	TAPEBUST	FD	0*A	00516	C6C5C 5C5C5	
00524		-0	TAPEBUST1	00517	77777 CC52C	
00525	TAPEBUST1	FD	0*IIIC	00520	16161 61CC5	
00526		FD	0*STATU	00521	3C31C 63132	
00527		FD	2*S S1	00522	3CC5C 53C61	
00530		-0	-0	00523	C5C5C 5C5C5	
00531	TAPSTAT	+0		00524	77777 77777	
00532		+0		00525	CCCCC CCCCC	
00533		+0		00526	CCCCC CCCCC	
				00527	CCCCC CCCCC	

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PLANETRACK FRACHTMAN*8/4/64

CARDS	L1 ID LABEL	TA STATEMENT	LOC	F JKB Y	NOTES
0C534	NEGOEC	JP BEAVER*QNEG	00530	60300 0025C	
0C535		SUB A*1	00531	21000 CCCC1	
0C536		JP BEAVER	00532	61000 CC25C	
0C537	NUTIN	ADD A*1	00533	20000 0C001	
0C540		SUB A*W(SLOTBLOCK)	00534	21030 01541	
0C541		JP BLOCKAY*APOS	00535	60600 00553	
0C542	BLOCKCEE	IN EPHEM*W(EPHEMB)	00536	73670 C0564	
0C543		NO-UP	00537	12000 CCC0C	
0C544		EX-FCT EPHEM*W(SRHIBIN)	00540	13670 0106C	
0C545		NO-UP	00541	12000 0CCCC	
0C546		EX-FCT EPHEM*W(TAPESEARCH)	00542	13670 01542	
0L547		JP $	00543	61000 00543	
0C550		IN EPHEM*W(EPHEMC)	00544	73670 00565	
0C551	PATCH	ENT A*40	00545	11000 CC04C	
0C552		EX-FCT EPHEM*W(SRHIBIN)	00546	13670 0106C	
0C553		RPL A+Y*W(TAPESEARCH)	00547	24030 01542	
0C554		EX-FCT EPHEM*W(TAPESEARCH)	00550	13670 01542	
0C555		JP $	00551	61000 00551	
0C556		JP NORMAL	00552	61000 00054	
0C557	BLOCKAY	IN EPHEM*W(EPHEMA)	00553	73670 00563	
0C560		ENT A*-40	00554	11040 77737	
0C561		EX-FCT EPHEM*W(SRHIBIN)	00555	13670 C106C	
0C562		RPL A+Y*W(TAPESEARCH)	00556	24030 01542	
0C563		EX-FCT EPHEM*W(TAPESEARCH)	00557	13670 01542	
0C564		JP $	00560	61000 C056C	
0C565		IN EPHEM*W(EPHEMB)	00561	73670 C0564	
0C566		JP PATCH	00562	61000 C0545	
0C567	EPHEMA	U-TAG AEPHEM+3190*AEPHEM	00563	C2252 01553	
0C570	EPHEMB	U-TAG AEPHEM+6390*AEPHEM+3200	00564	C2752 02253	
0C571	EPHEMC	U-TAG AEPHEM+9590*AEPHEM+6400	00565	C3452 02753	
0C572	BODIES	FO 0*A	00566	C6050 50505	
0C573		-0 BODIES1	00567	77777 C057C	
0C574	BODIES1	FO 0*MERCU	00570	22122 71032	
0C575		FO 0*RY(1)	00571	27365 1614C	
0C576		FO 0* VEN	00572	C5053 31223	
0C577		FU 0*US(2)	00573	32305 1624C	
0C600		FO 0* MAR	00574	C5052 20627	
0C601		FO 0* S(4)	00575	30516 44CC5	
0C602		FO 0* JUPI	00576	C5173 22516	
0C603		FO 0*TER(5	00577	31122 75165	
0C604		FO 0*) SA	00600	40050 530C6	
0C605		FO 0*TURN(	00601	31322 72351	
0C606		6640040332	00602	66400 40332	6) CRLF U
0C607		FC 0*RANUS	00603	27062 3323C	
0C610		FD 0*(7)	00604	51674 CC505	
0C611		FC 0*NCPTU	00605	23122 53132	
0C612		FC 0*NE(8)	00606	23125 17C4C	
0C613		-0	00607	77777 77777	
0C614	NODATA	FC 0*A	00610	C6C50 5C5C5	
0C615		-0 NODATA1	00611	77777 CC612	

CARDS

CARDS	L1 IO LABEL	TA	STATEMENT	LOC	F JKB Y		NCTES
•	0C616 NODATA1	FD	0*( ) E	00612	51054		00512
•	0C617	FD	0*PHEME	00613	25151		22212
•	0C620	FD	0*RIS F	00614	27163		00513
•	0C621	FO	0*OR	00615	24270		50505
	0C622 NODATA2	FD	0*63/63	00616	66637		46663
	0C623	FC	0* NOT	00617	C5232		43105
	0C624	FD	0*AMONG	00620	06222		42314
	0C625	FD	0* FIRS	00621	C5131		6273C
	0C626 NODATA3	FD	0*T	00622	31050		50505
	0C627	FC	0*FILES	00623	13162		1123C
	0C630	-0		00624	77777		77777
	0C631 INITIALJ0	FD	0*A	00625	C6050		50505
	0C632	U-TAG	INITIAL2*INITIAL1	00626	C0633		C0627
	0C633 INITIAL1	FD	0*JULIA	00627	17322		11606
	0C634	FD	2*N DAY	00630	23051		10636
				00631	C5050		50505
•	0C635	-0		00632	77777		77777
•	0C636 INITIAL2	FD	U*0	00633	11050		50505
•	0C637	-0	INITIAL3	00634	77777		00635
	0C640 INITIAL3	0		00635	C0000		0000C
	0C641 INITIALOAT	FD	0*A	00636	C6050		50505
	0C642	U-TAG	INITIAL11*INITIAL10	00637	C0644		00640
	0C643 INITIAL10	FD	3*DAY OF YEAR	00640	11063		60524
				00641	13053		61206
				00642	27050		50505
•	0C644	-0		00643	77777		77777
•	0C645 INITIAL11	FO	0*0	00644	11050		50505
•	0C646 INITIAL12	-0	INITIAL12	00645	77777		C0646
	0C647	0		00646	C0C00		CC00C
	0C650 RGHTASC	FO	0*A	00647	C6050		505C5
	0C651	U	RA1	00650	C0000		00665
	0C652	FO	0*0	00651	11050		50505
	0C653	0	RA2	00652	C0000		00671
	0C654	FO	0*A	00653	C6050		50505
	0C655	0	RA3	00654	C0000		00672
	0C656	FC	0*0	00655	11050		50505
	0C657	U	RA4	00656	C0000		C0674
	0C660	FO	0*A	00657	C6050		50505
	0C661	0	RA5	00660	C0000		00675
	0C662	FD	0*X2B23	00661	35620		76263
	0C663	0	RA6	00662	C0C00		C0677
	0C664	FD	0*A	00663	C6050		505C5
	0C665	-0	RA7	00664	77777		CC7CC
	0C666 RA1	FC	3*RIGHT ASC	00665	27161		41531
				00666	C5063		C10C5
				00667	C5050		50505
•	0C667	-0		0067C	77777		77777
•	0C67C RA2	U		00671	C0000		CCCCC
•	0C671 RA3	1505		00672	C0000		015C5
	0C672	-0		00673	77777		77777

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PLANETRACK

CARDS	LOC LABEL	TA STATEMENT	LOC	F JKB Y	NOTES
	0C673 RA4	0	00674	C0C00	CCCCC
	0C674 RA5	2205	00675	C0C00	C22C5
	0C675	-0	00676	77777	77777
	0C676 RA6	0	00677	C0C00	C000C
	0C677 RA7	30	00700	C0000	C003C
	0C7C0	-0	00701	77777	77777
	0C701 OLN	FD 0*A	00702	C6050	50505
	0C7D2	0 DLN1	00703	C0000	C072C
	0C703	FD 0*0	00704	11050	5C505
	0C704	0 OLN2	00705	C0000	00724
	0C705	FD 0*A	00706	C6050	50505
	0C706	0 DLN3	00707	C0000	C0725
	0C707	FD 0*D	00710	11050	50505
	0C710	0 OLN4	00711	C0000	C0727
	0C711	FD 0*A	00712	C6050	50505
	0C712	0 DLN5	00713	C0DD0	0073C
	0C713	FD 0*X2B23	00714	35620	76263
	0C714	0 DLN6	00715	C0000	00732
	0C715	FD U*A	00716	C6050	50505
	0C716	-0 OLN7	00717	77777	00733
	0C717 OLN1	FD 3*DECLINATION	00720	11121	C2116
			00721	23063	11624
	0C720	-0	00722	23050	50505
	0C721 OLN2	0	00723	77777	77777
	0C722 OLN3	1105	00724	C0000	C000C
	0C723	-0	00725	C0000	01105
	0C724 OLN4	0	00726	77777	77777
	0C725 OLN5	7205	00727	C0000	C000C
	0C726	-0	00730	C0D00	07205
	0C727 OLN6	0	00731	77777	77777
	0C730 OLN7	52	00732	C0D00	CCCCC
	0C731	-0	00733	C0C00	C0052
	0C732 GMT	FD 0*A	00734	77777	77777
	0C733	0 GMT1	00735	C6050	50505
	0C734	FD 0*0	00736	C0DD0	C0753
	0C735	0 GMT2	00737	11D50	50505
	0C736	FD 0*A	00740	C0000	C0757
	0C737	0 GMT3	00741	C6050	50505
	0C740	FD 0*0	00742	C0D00	C076C
	0C741	0 GMT4	00743	11D50	50505
	0C742	FD 0*A	00744	C0DD0	C0762
	0C743	0 GMT5	00745	C6D50	50505
	0C744	FC 0*X2B23	00746	C0CD0	CC763
	0C745	0 GMT6	00747	35620	76263
	0C746	FD 0*A	00750	C0C00	C0765
	0C747	-0 GMT7	00751	C6050	50505
	0C750 GMT1	FD 3*UNIVERSAL TIME	00752	77777	C0766
			00753	32231	63312
			00754	273D0	621C5
			00755	31162	21205

CARDS

L1 ID	LABEL	TA STATEMENT	LOC	F JKB Y	NOTES
0C751		-0	00756	77777 77777	
0C752	GMT2	0	00757	C0000 C000C	
0C753	GMT3	1505	00760	C0000 C1505	
0C754		-0	00761	77777 77777	
0C755	GMT4	0	00762	C0000 CCCCC	
0C756	GMT5	2205	00763	C0000 02205	
0C757		-0	00764	77777 77777	
0C760	GMT6	0	00765	C0000 C000C	
0C761	GMT7	30	00766	C0000 D003C	
0C762		-0	00767	77777 77777	
0C763	INITIALDIS	FD 0*A INITIAL17*INITIAL16	00770	C6050 505D5	
0C764		U-TAG 0*DISTA	00771	C0776 00772	
0C765	INITIAL16	FD 0*DISTA	00772	11163 03106	
0C766		FD 0*NCE	00773	23101 20505	
0C767		FD 0*A U	00774	C6053 20505	
0C770		-0	00775	77777 77777	
0C771	INITIAL17	FD 0*X7B24	00776	35670 76264	
0C772		-0 INITIAL18	00777	77777 D100C	
0C773	INITIAL18	0	01000	C0000 0000C	
0C774	INITIALBOD	FD 0*A INITIAL20*INITIAL19	01001	C6050 50505	
0C775		U-TAG	01002	C1007 D10C3	
0C776	INITIAL19	FD 3*PLANET	01003	25210 62312	
0C777		-0	01004	31050 50505	
01000	INITIAL20	FD 0*A INITIAL21	01005	C5050 505C5	
01001	INITIAL21	-0	01006	77777 77777	
01002		0	01007	C6050 50505	
01003		0	0101C	77777 C1011	
01004		-0	01011	C0000 CCCCC	
01005	MERCURY	FD 2*MERCURY	01012	C5050 73005	
01006		FD 2*VENUS	01013	77777 77777	
01007		FD 2*EARTH	01014	22122 71032	
01010		FD 2*MARS	01015	27360 50505	
01011		FD 2*JUPITER	01016	33122 3323C	
01012		FD 2*SATURN	01017	C5050 5C5C5	
01013		FD 2*URANUS	0102C	12062 73115	
01014		FD 2*NEPTUNE	U1021	C5050 5C5C5	
01015	INPLANET	FD 0*0	01022	22062 73005	
01016		11 PLAN	01023	C5050 50505	
01017		1	01024	17322 51631	
0102D		8D	01025	12270 50505	
			01026	30063 13227	
			01027	23050 50505	
			0103C	32270 62332	
			01031	30050 505C5	
			01032	23122 53132	
			01033	23120 50505	
			01034	11C50 505C5	
			01035	CCC11 C104C	
			01036	C0000 CCCC1	
			01037	C0000 CCC1C	

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CARDS	LI IO LABEL	TA STATEMENT	LOC	F JKB Y	ACTES		BINA
01021	PLAN	0	0104C	C0000 CCCCC			
01022	MONTHPRINT	0	01041	C0000 OCOCC			
01023		0061000000	01042	C0610 0000C			
01024		0062000000U	01043	C0620 C000C			
01025		0063000000	01044	C0630 C000C			
01026		0064000000	01045	C0640 0000C			
01027		0065000000	01046	C0650 C000C			
01030		0066000000	01047	C0660 C000C			
01031		0067000000	01050	C0670 C000C			
01032		0070000000	01051	C0700 C000C			
01033		0071000000	01052	C0710 0000C			
01034		6160000000	01053	61600 COCCC			
01035		6161000000	01054	61610 COCCC			
01036		6162000000	01055	61620 0000C			
01037	HALFOAY	1000000000	01056	10000 C000C			
01040	REVSRAOIAN	2427630154	01057	24276 30154	CEC		C.63661977829
01041	SRHIBIN	560000000002	01060	56C00 C0002	1 B RY		SEARCH HIOENSITY BINA
01042	INTERUPT	RJP STATUSCK	01061	65000 004C5			
01043	IGNORE	6000000000	01062	60000 0000C			
01044	REWINONO	2010000002	01063	20100 C0002	1 B	NC INT	
01045	SRAO	3266677126	01064	32666 77126	OEC 200/PI	13750.987B15	43
01046	HRAD	1030124435	01065	10301 24435	CEC /12	.26179939R29	PI
01047	MINSRAD	2167643241	01066	21676 43241	OEC BPI/72C	.55850536829	12
01050	HOAY	1252525250	01067	12525 2525C	OEC 24 B32	.33333333B29	8/
01051	MOAY	2660266026	0107C	26602 66026	CEC 10/1440	.71111111829	2E
01052	SDAY	2506000000	01071	25060 00C0C	OEC	B6400.000B12	
01053	SECSRAD	2304045527	01072	23C40 45527	CEC 13PI/432C0	.59573905829	2E
01054	SARAD	3113343172	01073	31133 43172	CEC 8C0/PI	206264.81B11	64
01055	RDRSEC	3021344241	01074	30213 44241	CEC 6/86400	.75851852B29	2E1
01056	AUONMSEC	3515643656	01075	35156 43656	DEC	934.91B19	
01057	TWOPIE	3110375523	01076	31103 75523	CEC	6.2831853B26	
01060	YCARPRINT	0000746661	01077	C0007 46661			
01061		0000746662	0110C	C0007 46662			
01062		0000746663	01101	C0C07 46663			
01063		0000746664	01102	C00U7 46664			
01064		0000746665	01103	C0C07 46665			
01065		0000746666	01104	C0C07 46666			

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CARDS	L1 I0 LABEL	TA STATEMENT	LOC	F JKB	Y	NCTFS
01066		0000746667	01105	C0007	46667	
01067		0000746670	01106	C0007	4667C	
01070		0000746671	01107	C0007	46671	
01071	KEY	4000000000	0111C	40000	C000C	
01072	FIRSTDIFF	0	01111	CUC00	C000C	
01073	BETA	0	01112	C0C00	C000C	
01074	GAMMA	0	01113	C0000	CC00C	
01075	DELTA	0	01114	C0000	C000C	
01076	EPSILON	0	01115	C0000	C000C	
01077	FUNCTION	0	01116	C0000	C000C	
01100	P	0	01117	C0000	CC00C	
01101	HALF	2000000000	01120	20000	CC00C	
01102	OMINB	U	01121	C0000	00000	
01103	DMIN2CPLB	0	01122	C0C00	C000C	
01104	EP28M2DMA	0	01123	C0000	CC00C	
01105	BESSEL	U	01124	C0000	C000C	
01106		0	01125	C0000	C000C	
01107		0	01126	C0000	C000C	
01110		0	01127	C0000	C000C	
01111		0	0113C	C0000	CC00C	
01112	SETINTAO	0	01131	C0000	C000C	
01113	PSQMP	0	01132	C0000	C000C	
01114	PSQMP6	0	01133	C0000	CC00C	
01115	THIRD	1252525252	01134	12525	25252	
01116	SIXTH	0525252525	01135	C5252	52525	
01117	KENNEOY	0	01136	C0000	00000	
01120	NUMDERIV	0	01137	C0000	C000C	
01121	BESSEL3	ENT Q*-12	0114C	10040	77765	
01122		RPL Y+Q*L(SETINTAO)	01141	34010	01131	
01123		ENT B3*L(SETINTAD)	01142	12310	01131	
01124		CL Q*	01143	10000	CC00C	
01125		JP MUNICH	01144	61000	01164	
01126	FRESSEL	0	01145	C0000	CC00C	
01127		U	01146	C0000	00000	
01130		0	01147	C0000	C000C	
01131		0	0115C	C0000	CC00C	
01132		0	01151	C0000	00000	
01133	INTERPOL	ENTRY	01152	61000	00000	
01134		ENT Q*2	01153	10000	CC002	
01135		COM Q*U(I0ENT)*YLESS	01154	C4220	C1533	
01136		JP BESSEL3	01155	61000	C114C	
01137		ENT Q*-24	01156	10040	77753	
01140		RPL Y+Q*L(SETINTAO)	01157	34010	C1131	
01141		ENT B3*L(SETINTAD)	0116C	12310	C1131	
01142		ENT A*W(O+B3)	01161	11033	CC00C	
01143		STR A*W(FIRSTDIFF)	01162	15C30	01111	
01144		ENT B3*12+B3	01163	12303	CC012	
01145	MUNICH	ENT A*W(O+B3)	01164	11033	CC00C	
01146		STR A*W(BETA)	01165	15C30	C1112	
01147		ENT B3*12+B3	01166	12303	CC012	

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CARDS	L1 ID LABEL	TA STATEMENT	LOC	F JKB Y	NOTES
01150		ENT A*W(0+B3)	01167	11033	C000C
01151		STR A*W(GAMMA)	01170	15030	C1113
01152		ENT B3*12+B3	01171	12303	C0012
01153		ENT A*W(0+B3)	01172	11033	C000C
01154		STR A*W(DELTA)*QNEG	01173	15330	01114
01155		JP EGRESS	01174	61000	0120C
01156		ENT B3*12+B3	01175	12303	C0012
01157		ENT A*W(0+R3)	01176	11033	C000C
01160		STR A*W(EPSILON)	01177	15030	01115
01161	EGRESS	ENT A*W(DELTA)	01200	11030	01114
01162		SUB A*W(BETA)	01201	21030	C1112
01163		STR A*W(DMINB)	01202	15030	01121
01164		ADD A*W(OMINB)	01203	20030	01121
01165		STR A*W(BESSEL)	01204	15030	01124
01166		ENT A*W(DELTA)	01205	11030	01114
01167		ADD A*W(BETA)	01206	20030	01112
01170		SUB A*W(GAMMA)	01207	21030	01113
01171		SUB A*W(GAMMA)	01210	21030	01113
01172		STR A*W(OMIN2CPLB)	01211	15030	01122
01173		JP DIFF4ZERO*QPOS	01212	60200	01364
01174		ENT A*W(EPSILON)	01213	11030	01115
01175		SUB A*W(FIRSTDIFF)	01214	21030	01111
01176		SUB A*W(BESSEL)	01215	21030	01124
01177		STR A*W(EP2BM2DMA)	01216	15030	01123
01200	PARTIAL	ENT Q*W(P)	01217	10030	01117
01201		MUL W(GAMMA)	01220	22030	01113
01202		LSH AQ*1	01221	C7000	00001
01203		STR A*W(BESSEL+1)	01222	15030	01125
01204		STR A*W(BESSEL)*APOS	01223	15630	01124
01205		JP NEGRESS1	01224	61000	01466
01206		LSH AQ*290	01225	C7000	00035
01207		SEL CL*W(KEY)	01226	52030	0111C
01210	STOR1	STR A*W(FBESSEL)	01227	15030	01145
01211		STR A*W(FBESSEL+1)	01230	15030	01146
01212		ENT Q*W(P)	01231	10030	01117
01213		MUL W(P)	01232	22030	01117
01214		ENT B5*1	01233	12500	C0001
01215		RJP LEFRNDOFF	01234	65C00	01502
01216		SUB A*W(P)	01235	21030	01117
01217		STR A*W(PSQMP)	01236	15030	01132
01220		RSH AQ*300	01237	C3000	00036
01221		MUL W(DMINB)	01240	22030	01121
01222		RSH AQ*1	01241	C3000	C0001
01223		STR A*W(BESSEL+2)*APOS	01242	15630	01126
01224		JP NEGBESS2	01243	61C00	C1471
01225		LSH AQ*29D	01244	C7C00	CCC35
01226		SEL CL*W(KEY)	01245	52030	0111C
01227	STOR2	STR A*W(FBESSEL+2)	01246	15030	01147
01230		ENT A*W(PSQMP)	01247	11C30	01132
01231		RSH AQ*30D	0125C	C3CCU	00036

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CARDS	L1 IO LABEL	TA	STATEMENT	LOC	F	JKB	Y	NOTES
01232		DIV	6**AZERO	01251	23400	00006		
01233		JP	REMAINDER	01252	61000	01366		
01234	LINCOLN	STR	Q**W(PSQMP6)	01253	14030	01133		
01235		ENT	Q**W(P)	01254	10030	01117		
01236		SUB	Q**W(HALF)	01255	27030	0112C		
01237		MUL	W(PSQMP6)	01256	22030	01133		
01240		RJP	LEFRNOOFF	01257	65000	01502		
01241		RSH	AQ**300	0126C	C3000	00036		
01242		MUL	W(OMIN2CPLB)	01261	22030	01122		
01243		LSH	AQ**1	01262	C7000	00001		
01244		STR	A**W(BESSEL+3)**APOS	01263	15630	01127		
01245		JP	NEGBESS3	01264	61000	01474		
01246		LSH	AQ**290	01265	C7000	00035		
01247		SEL	CL**W(KEY)	01266	52030	0111C		
01250	STOR3	STR	A**W(FBESSEL+3)	01267	15030	0115C		
01251		ENT	A**W(EP28M2DMA)**ANOT	01270	11530	01123		
01252		JP	NOFOURTH	01271	61000	01361		
01253		ENT	Q**W(PSQMP6)	01272	10030	01133		
01254		SUB	Q**W(THIRD)	01273	27030	01134		
01255		MUL	W(PSQMP)	01274	22030	01132		
01256		RJP	LEFRNOOFF	01275	65000	01502		
01257		RSH	AQ**300	01276	C3000	00036		
01260		MUL	W(EP28M2DMA)	01277	22030	01123		
01261		RSH	AQ**2	01300	C3000	00002		
01262		STR	A**W(BESSEL+4)**APOS	01301	15630	0113C		
01263		JP	NEGBESS4	01302	61000	01477		
01264		LSH	AQ**290	01303	C7000	00035		
01265		SEL	CL**W(KEY)	01304	52030	0111C		
01266	STOR4	STR	A**W(FBESSEL+4)	01305	15030	01151		
01267		ENT	A**W(FBESSEL)	01306	11030	01145		
01270		SEL	CP**W(FBESSEL+2)	01307	51030	01147		
01271		JP	FLOTEST1**APOS	01310	60600	0140C		
01272	NUFLO1	ENT	Q**W(BESSEL+2)	01311	10030	01126		
01273	FIX1	RPL	Y+Q**W(BESSEL)	01312	34030	01124		
01274		ENT	A**W(FBESSEL+2)	01313	11030	01147		
01275		RPL	A+Y**W(FBESSEL)	01314	24030	01145		
01276		SEL	CP**W(FBESSEL+3)	01315	51030	0115C		
01277		JP	FLOTEST2**APOS	01316	60600	01422		
01300	NUFLO2	ENT	Q**W(BESSEL+3)	01317	10030	01127		
01301	FIX2	RPL	Y+Q**W(BESSEL)	0132C	34030	01124		
01302		ENT	A**W(FBESSEL+3)	01321	11030	0115C		
01303		RPL	A+Y**W(FBESSEL)	01322	24030	01145		
01304		SEL	CP**W(FRESSEL+4)	01323	51030	01151		
01305		JP	FLOTEST3**APOS	01324	60600	01444		
01306	NUFLO3	ENT	Q**W(BESSEL+4)	01325	10030	0113C		
01307	FIX3	RPL	Y+Q**W(BESSEL)	01326	34030	01124		
01310		ENT	A**W(FBESSEL+4)	01327	11030	01151		
01311		RPL	A+Y**W(FBESSEL)	0133C	24030	01145		
01312		ENT	Q**W(P)	01331	10030	01117		
01313		SUB	Q**W(HALF)	01332	27030	0112C		

CARDS	L1 ID LABEL	TA	STATEMENT	LOC	F JKB	Y	NOTES
01314		MUL	W(OMINB)	01333	22030	01121	
01315		CL	B5*	01334	12500	0000C	
01316		RJP	LEFRNOOFF	01335	65000	01502	
01317		STR	A*W(KENNEDY)	01336	15030	01136	
01320		ENT	Q*W(PSQMP)	01337	10030	01132	
01321		ADD	Q*W(SIXTH)	01340	26030	01135	
01322		MOL	W(DMIN2CPLB)	01341	22030	01122	
01323		RJP	LEFRNDOFF	01342	65000	01502	
01324		ADD	A*W(KENNEDY)	01343	20030	01136	
01325		ADD	A*W(GAMMA)	01344	20030	01113	
01326		STR	A*W(NUMOERIV)	01345	15030	01137	
01327		ENT	A*W(FBESSEL)*APOS	01346	11630	01355	
01330		JP	MINUS	01347	61000	01355	
01331		LSH	A*1*ANEG	0135C	C6700	C0001	
01332		ENT	A*W(BESSEL)*SKIP	01351	11130	01124	
01333		RPL	Y+1*W(BESSEL)	01352	36030	01124	
01334	SUM	ADD	A*W(O+B4)	01353	20034	0000C	
01335		EXIT		01354	61010	01152	
01336	MINUS	LSH	A*1*APOS	01355	C6600	C0001	
01337		ENT	A*W(BESSEL)*SKIP	01356	11130	01124	
01340		RPL	Y-1*W(BESSEL)	01357	37030	01124	
01341		JP	SUM	01360	61000	01353	
01342	NOFOURTH	CL	A*	01361	11000	0000C	
01343		STR	A*W(BESSEL+4)	01362	15030	0113C	
01344		JP	STOR4	01363	61000	01305	
01345	DIFF4ZERO	STR	Q*W(EP2BM2OMA)	01364	14030	01123	
01346		JP	PARTIAL	01365	61600	01217	
01347	REMAINDER	JP	CIVIL*QPOS	01366	60200	01374	
01350		STR	A*A	01367	15040	0000C	
01351		SUB	A*3*APOS	01370	21600	CC003	
01352		JP	LINCOLN	01371	61C00	01253	
01353		SUB	Q*1	01372	27000	00001	
01354		JP	LINCOLN	01373	61C00	01253	
01355	CIVIL	SUB	A*3*APOS	01374	21600	CC003	
01356		JP	LINCOLN	01375	61000	01253	
01357		ADD	Q*1	01376	26000	00001	
01360		JP	LINCOLN	01377	61000	01253	
01361	FLOTEST1	ENT	A*W(FBESSEL)*ANEG	01400	11730	01145	
01362		ADD	A*W(FBESSEL+2)*SKIP	01401	20130	01147	
01363		JP	BOTHNEG1	01402	61000	01412	
01364		JP	NOFLO1*APOS	01403	60600	01311	
01365		SEL	CL*W(KEY)	01404	52030	0111C	
01366		STR	A*W(FBCSSEL)	01405	15030	01145	
01367		ENT	Q*W(BCSSEL+2)	01406	10030	01126	
01370		ADD	Q*1	01407	26000	00001	
01371		RPL	Y+Q*W(BESSEL)	0141C	34030	01124	
01372		JP	FIX1+3	01411	61000	01315	
01373	BOTHNEG1	ADD	A*W(FBESSEL+2)	01412	20030	01147	
01374		JP	NOFLO1*ANEG	01413	60700	01311	
01375		SEL	SET*W(KEY)	01414	50030	0111C	

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CARDS	L1 I0 LABEL	TA	STATEMENT	LOC	F	JKB Y	NOTES
01376		STR	A*W(FBESSEL)	01415	15030	01145	
01377		ENT	Q*W(BESSEL+2)	01416	10030	01126	
01400		SUB	Q*1	01417	27000	00001	
01401		RPL	Y+Q*W(BESSEL)	01420	34030	01124	
01402		JP	FIX1+3	01421	61000	01315	
01403	FLOTEST2	ENT	A*W(FBESSEL)*ANEG	01422	11730	01145	
01404		ADD	A*W(FBESSEL+3)*SKIP	01423	20130	0115C	
01405		JP	BOTHNEG2	01424	61000	01434	
01406		SEL	NOFLO2*APOS	01425	60600	01317	
01407		SEL	CL*W(KEY)	01426	52030	0111C	
01410		STR	A*W(FBESSEL)	01427	15030	01145	
01411		ENT	Q*W(BESSEL+3)	01430	10030	01127	
01412		ADD	Q*1	01431	26000	00001	
01413		RPL	Y+Q*W(BESSEL)	01432	34030	01124	
01414		JP	FIX2+3	01433	61000	01323	
01415	BOTHNEG2	ADD	A*W(FBESSEL+3)	01434	20030	0115C	
01416		JP	NOFLO2*ANEG	01435	60700	01317	
01417		SEL	SET*W(KEY)	01436	50030	0111C	
01420		STR	A*W(FBESSEL)	01437	15030	01145	
01421		ENT	Q*W(BESSEL+3)	01440	10030	01127	
01422		SUB	Q*1	01441	27000	00001	
01423		RPL	Y+Q*W(BESSEL)	01442	34030	01124	
01424		JP	FIX2+3	01443	61000	01323	
01425	FLOTEST3	ENT	A*W(FBESSEL)*ANEG	01444	11730	01145	
01426		ADD	A*W(FBESSEL+4)*SKIP	01445	20130	01151	
01427		JP	BOTHNEG3	01446	61000	01456	
01430		JP	NOFLO3*APOS	01447	60600	01325	
01431		SEL	CL*W(KEY)	01450	52030	0111C	
01432		STR	A*W(FBESSEL)	01451	15030	01145	
01433		ENT	Q*W(BESSEL+4)	01452	10030	0113C	
01434		ADD	Q*1	01453	26000	00001	
01435		RPL	Y+Q*W(BESSEL)	01454	34030	01124	
01436		JP	FIX3+3	01455	61000	01331	
01437	BOTHNEG3	ADD	A*W(FBESSEL+4)	01456	20030	01151	
01440		JP	NOFLO3*ANEG	01457	60700	01325	
01441		SEL	SET*W(KEY)	01460	50030	0111C	
01442		STR	A*W(FBESSEL)	01461	15030	01145	
01443		ENT	Q*W(BESSEL+4)	01462	10030	0113C	
01444		SUB	Q*1	01463	27000	00001	
01445		RPL	Y+Q*W(BESSEL)	01464	34030	01124	
01446		JP	FIX3+3	01465	61000	01331	
01447	NEGBESS1	LSH	AQ*29D	01466	C7000	CC035	
01450		SEL	SET*W(KEY)	01467	50030	0111C	
01451		JP	STOR1	01470	61000	C1227	
01452	NEGRESS2	LSH	AQ*29D	01471	C7000	CC035	
01453		SEL	SET*W(KEY)	01472	50030	0111C	
01454		JP	STOR2	01473	61000	01246	
01455	NEGRESS3	LSH	AQ*29D	01474	C7000	CC035	
01456		SEL	SET*W(KEY)	01475	50030	0111C	
01457		JP	STUR3	01476	61C00	01267	

SPURT OUTPUT NO. 21C   FRACHTMAN*8/4/64

PLANETRACK

CARDS	L1 ID LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
.	01460 NEGBESS4	LSH AQ*29D	01477	C7C00	C0035		
.	01461	SEL SET*W(KEY)	01500	5003C	0111C		
.	01462	JP STOR4	01501	61000	01305		
.	01463 LEFRNDOFF	ENTRY	01502	61000	C000C		ENTER WITH B5 SET TO SHIFTS
.	01464	JP MIKE*ANEG	01503	60700	01507		
.	01465	LSH AQ*B5*QPOS	01504	07205	C000C		
.	01466	ADD A*1	01505	20000	00001		
.	01467	EXIT	01506	61010	01502		
.	01470 MIKE	LSH AQ*B5*QNEG	01507	C7305	00001		
.	01471	SUB A*1	01510	21000	00001		
.	01472	EXIT	01511	61010	01502		
.	01473 RUUNDOFF	ENTRY	01512	61000	C000C		ENTER WITH B5 SET TO SHIFTS
.	01474	JP MAX*ANEG	01513	60700	01517		
.	01475	RSH AQ*B5*QPOS	01514	C3205	C000C		
.	01476	AQO A*1	01515	20000	00001		
.	01477	EXIT	01516	61010	01512		
.	01500 MAX	RSH AQ*B5*QNEG	01517	C3305	00001		
.	01501	SUB A*1	01520	21000	00001		
.	01502	EXIT	01521	61010	01512		
.	01503 PLANRAO	0	01522	C0000	C000C		
.	01504	0000000427	01523	C0000	00427		CEC MER C.39
.	01505	0000001266	01524	C0000	01266		CEC VEN US.97
.	01506	0	01525	C0000	C000C		
.	01507	0000000665	01526	C0000	00665		CEC MAR S.53
.	01510	0000017510	01527	C0C00	17510		CEC JUP ITER11.19
.	01511	0000015171	01530	C0C00	15171		CEC SAT URN9.47
.	01512	00U0005121	01531	C0000	05121		CEC URA NUS3.69
.	01513	0000004711	01532	C0000	C4711		CEC NEP TUNE3.50
.	01514 IDENT	0	01533	C0000	C000C		
.	01515 YRREMAIN	0	01534	C0000	C000C		
.	01516 WHOLEYEAR	0	01535	C0000	C000C		
.	01517 JULIANDAY	0	01536	C0000	C000C		
.	01520 IMPERIAL	U	01537	C0000	C000C		
.	01521 TAPEBLOCK	0	01540	C0000	C000C		
.	01522 SLOTBLOCK	0	01541	C0000	C000C		
.	01523 TAPESEARCH	0	01542	C0000	C000C		
.	01524 RAAO	0	01543	C0000	C000C		
.	01525 DECAD	U	01544	C0000	C000C		
.	01526 DISTAD	U	01545	C0000	C000C		
.	01527 RADIFAD	U	01546	C0000	C000C		
.	01530 DECDIFAO	U	01547	C0C00	C000C		
.	01531 OISTOIFAO	U	01550	C0C00	C000C		
.	01532 SAIGON	0	01551	C0000	C000C		

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PLANETRACK   FRACHTMAN*8/4/64

CARDS	L1 ID LABEL	TA STATEMENT	LOC	F JKB Y	NOTES
.	01533 SAFE	0	01552	C0000 0C0CC	
.	01534 AEPHEM	RESERVE 959D	01553	C0000 0C0CC	
.	01535 LASTEPHEM	0	03452	C0000 0000C	
.	01536	RESERVE 1	03453	C0000 0000C	
			03454	C0112 30264	
			03455	C0112 32007	
			03456	51004 0C512	
			03457	31050 00005	

PLANETRACK   FRACHTMAN*8/4/64

LABEL	LOC	LABEL	LOC	LABEL	LOC
ASSSS61111	03454	ASSSSS1112	03455	ASSSSS1113	03456
ASSSS61114	03457	ACQAZIM	63071	ACQELEV	63075
ACQUI	63427	ACTUALTIME	63142	ADSCN	63416
AEPHEM	01553	AESCN	63417	AIRPORT	00214
ALBERT	00463	ASTRODEC	63106	ASTRORA	63105
AUCONVER	63332	AUDNMSEC	01075	AZIM	63053
AZIMOUT	64000	AZIMOVER	63325	AZIMACC	63442
AZIMIN	75000	BODIES	00566	BODIES1	00570
BUTHNEG1	01412	BOTHNEG2	01434	BOTHNEG3	01456
BARRIER	00474	BEAVER	00250	BESSEL	01124
BESSEL3	01140	BETA	01112	BLOCKAY	00553
BLOCKBEE	00046	BLOCKCFE	00536	BLASTOFF	63146
BUST	00477	COCON	63414	CONVERTIME	63135
CORCT	63420	COSORIENT	63065	COSAZEL	63070
CANTFIND	00436	CAZIM	63060	CELCOMPGM	63424
CELEV	63061	CELTIME	63133	CERO	00351
CHCOR	63422	CHPAR	63431	CIVIL	01374
CRANGE	63057	CRUISE	00100	DOPPOUT	66000
DOPPADD	63444	DATANALYZE	63425	DAY	63150
DAYFIND	00312	DAYINCRMNT	00326	DAYINCEX	00325
DEC	63003	DECAD	01544	DECDCT	63010
OECDIFAO	01547	DELTA	01114	DELTATEE	63316
DIFF4ZERO	01364	DISTAD	01545	DISTDIFAC	01550
DLN	00702	DLN1	0072C	CLN2	00724
DLN3	00725	DLN4	00727	CLN5	00730
OLN6	00732	CLN7	00733	CMIN2CPLB	01122
DMINB	01121	DSECONDS	63141	DUMSECTTG	63154
DYDMP	63421	EGRESS	0120C	ELEV	63054
ELEVOUT	65000	ELEVADO	63443	ELEVIN	76000
ENDFILE	00473	EP2BM2OMA	01123	EPHEMA	00563
EPHEMB	00564	EPHEMC	00565	EPSILCN	01115
EQUATUR	63323	ERASE	00011	ESTSHIFTEC	63143
EXPNAME	63350	FBESSEL	01145	FIRSTDIFF	01111
FIRSTELEV	63104	FIRSTHRU	63153	FIX1	01312
FIX2	01320	FIX3	01326	FLCTEST1	01400
FLOTEST2	01422	FLOTEST3	01444	FLATNEG	00274
FRAMESIZE	63101	FREQUENCY	63317	FUNCTICN	01116
GAMMA	01113	GEOCENLAT	63322	GEODETLAT	63321
GMT	00735	GMT1	00753	GMT2	00757
GMT3	00760	GMT4	00762	GMT5	00763
GMT6	00765	GMT7	00766	GMTMDDU24	63145
GMTSHIFTED	63144	HOURMINUTE	63137	HDURREG	63151
HALF	01120	HALFDAY	01056	HDAY	01067
HEIGHT	63326	HENRY	0000C	HRAD	01065
ID10RADIO	66777	ID11RADIO	67776	ID12RADIO	67777
ID13RADIO	70775	ID14RADIO	70776	ID15RADIC	71776
ID16RADIO	71777	ID17RADIO	72776	ID18RADIC	72777
ID19RADIO	73776	ID1CELCOR	6300C	IC1ENTPNT	63210
ID1RADCOR	63050	IO1RADIO	63440	ID1RECRC	63210
ID1SYSENT	77576	ID1SYSNAM	77676	ID1SYSPAR	63310
ID1ITIME	63130	ID2ORADIO	73777	ID21RADIC	74776

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PLANETRACK   FRACHTMAN-8/4/64

LABEL	LOC	LABEL	LOC	LABEL	LOC
ID22RADIO	74777	ID23RADIO	75776	ID24RADIO	75777
ID25RADIO	76775	ID26RADIO	76776	ID2CELCOR	63001
ID2ENTPNT	63411	ID2RADCOR	63051	ID2RADIO	63441
ID2RECRD	63211	ID2SYSENT	77577	ID2SYSNAM	77677
ID2SYSPAR	63311	ID2TIME	63131	ID3RADIO	63776
ID4RADIO	63777	ID5RADIO	64776	ID6RADIO	64777
ID7RADIO	65776	ID8RADIO	65777	ID9RADIO	66776
IOENT	01533	IGNORE	01062	IMPERIAL	01537
INAZIMADD	63446	INELEVADD	63447	INITIAL1	00627
INITIAL10	00640	INITIAL11	00644	INITIAL12	00646
INITIAL16	00772	INITIAL17	00776	INITIAL18	01000
INITIAL19	01003	INITIAL2	00633	INITIAL2C	01007
INITIAL21	01011	INITIAL3	00635	INITIALBCD	01001
INITIALOAT	00636	INITIALOIS	00770	INITIALJC	00625
INPLANET	01034	INTER	63413	INTERAZIM	72000
INTERCOM	63426	INTEROOPP	74000	INTERELEV	73000
INTERPOL	01152	INTERRANGE	76777	INTERUPT	01061
JULIANQAY	01536	KENNEDY	01136	KEY	01110
LONGITUDE	63320	LASTEPHEM	03452	LEFRNDOFF	01502
LESSONE	00310	LINCOLN	01253	MOOSE	00231
MONITAPE	00055	MONTHPRINT	01041	MAINSWITCH	63334
MAX	01517	MCPFILLER	71000	MCPGM	63412
MDAY	01070	MERCURY	01014	MIKE	01507
MINREG	63152	MINSRAQ	01066	MINUS	01355
MUNICH	01164	NODATA	00610	NODATA1	00612
NODATA2	00616	NODATA3	00622	NOFOURTH	01361
NOFLO1	01311	NOFLO2	01317	NOFLO3	01325
NORMAL	00054	NOTIN	00533	NEGBESS1	01466
NEGBESS2	01471	NEGBESS3	01474	NEGBESS4	01477
NEGDEC	00530	NEGTIME	00327	NUMDERIV	01137
P	01117	POLE	63324	PARTIAL	01217
PATCH	00545	PLAN	01040	PLANETCONT	00216
PLANETINIT	00002	PLANP	63434	PLANRAD	01522
PRLOG	63423	PSQMP	01132	PSQMP6	01133
ROUNDOFF	01512	RA	63002	RA1	00665
RA2	00671	RA3	00672	RA4	00674
RA5	00675	RA6	00677	RA7	00700
RAAD	01543	RADOT	63007	RADARMODE	63312
RADIOMETER	63102	RADIFAD	01546	RADIUS	63006
RADIUSDOT	63011	RANGE	63052	RANGEOUT	70777
RANGEADD	63445	RANGEDOT	63062	RDMTR	63430
RDRSEC	01074	RDXXX	63433	RECAZIM	67000
RECELEV	70000	RECFILE	63212	RECRD	63415
REMAINDER	01366	REVSRADIAN	01057	REWINDNO	01063
RGHTASC	00647	SAFE	01552	SAIGCN	01551
SARAD	01073	SAZIM	63055	SCELTIME	63134
SDAY	01071	SDEC	63005	SEAPCRT	00273
SECONDS	63140	SECSRAD	01072	SELEV	63056
SETBODY	00171	SETINTAD	01131	SIDERTIME	63012
SINORIENT	63064	SINAZEL	63066	SIXTH	01135
SKIP	63331	SLOTBLOCK	01541	SRA	63004

PLANETRACK

FRACHTMAN=8/4/64

LABEL	LOC	LABEL	LOC	LABEL	LOC
SKAD	01064	SRADTIME	63136	SRHIBIN	01060
STOR1	01227	STOR2	01246	STOR3	01267
STOR4	01305	STORE	00352	STATACT	00416
STATUSCK	00405	SUM	01353	SYSENTRIES	77600
SYSNAMES	77700	SYSTAT1	63313	SYSTAT2	63314
SYSTAID	63315	TAPEBLOCK	01540	TAPEBUST	00516
TAPEBUST1	00520	TAPEINPUT	00035	TAPESEARCH	01542
TAPSTAT	00525	THIRD	01134	TIMEMODE	63103
TIMEP	63435	TIMESLIDE	00335	TRUERANGE	63063
TRUETIME	63132	TRYAGAIN	00040	TWOLESS	00306
TWUPIE	01076	VIZDEC1	63014	VIZDEC2	63016
VIZRA1	63013	VIZRA2	63015	WFORD	63432
WFADD	63450	WFFREQ	63333	WHOLEYEAR	01535
YEARMONTH	63147	YEARPRINT	01077	YRREMAIN	01534
YRTRAN	63327	ZRTRAN	63330		

PLANETRACK

LABEL	LOC	LABEL	LOC	LABEL	LOC
HENRY	00000	PLANETINIT	00002	ERASE	00011
TAPEINPUT	00035	TRYAGAIN	00040	BLDCKBEE	00046
NORMAL	00054	MONITAPE	00055	CRUISE	00100
SETBODY	00171	AIRPORT	00214	PLANETCONT	00216
MOOSE	00231	BEAVER	00250	SEAPORT	00273
FLATNEG	00274	TWOLESS	00306	LESSONE	00310
DAYFIND	00312	DAYINDEX	00325	DAYINCRMNT	00326
NEGTIME	00327	TIMESLIOE	00335	CERD	00351
STORE	00352	STATUSCK	00405	STATACT	00416
CANTFIND	00436	ALBERT	00463	ENDFILE	00473
BARRIER	00474	BUST	00477	TAPEBUST	00516
TAPEBUST1	00520	TAPSTAT	00525	NEGDEC	00530
NOTIN	00533	BLOCKCEE	00536	PATCH	00545
BLOCKAY	00553	EPHEMA	00563	EPHEMB	00564
EPHEMC	00565	BODIES	00566	BODIES1	00570
NODATA	00610	NOOATA1	00612	NODATA2	00616
NODATA3	00622	INITIALJO	00625	INITIAL1	00627
INITIAL2	00633	INITIAL3	00635	INITIALDAT	00636
INITIAL10	00640	INITIAL11	00644	INITIAL12	00646
RGHTASC	00647	RA1	00665	RA2	00671
RA3	00672	RA4	00674	RA5	00675
RA6	00677	RA7	00700	DLN	00702
OLN1	00720	DLN2	00724	OLN3	00725
OLN4	00727	DLN5	00730	DLN6	00732
OLN7	00733	GMT	00735	GMT1	00753
GMT2	00757	GMT3	00760	GMT4	00762
GMT5	00763	GMT6	00765	GMT7	00766
INITIALOIS	00770	INITIAL16	00772	INITIAL17	00776
INITIAL1B	01000	INITIALBDD	01001	INITIAL19	01003
INITIAL20	01007	INITIAL21	01011	MERCURY	01014
INPLANET	01034	PLAN	01040	MCNTHPRINT	01041
HALFDAY	01056	REVSRADIAN	01057	SRHIBIN	01060
INTERUPT	01061	IGNORE	01062	REWINDNO	01063
SRAO	01064	HRAO	01065	MINSRAD	01066
HDAY	01067	MDAY	01070	SDAY	01071
SECSRAO	01072	SARAD	01073	RDRSEC	01074
AUDNMSEC	01075	TWOPIE	01076	YEARPRINT	01077
KEY	01110	FIRSTDIFF	01111	BETA	01112
GAMMA	01113	DELTA	01114	EPSILON	01115
FUNCTION	01116	P	01117	HALF	01120
DMINB	01121	DMIN2CPLB	01122	EP2BM2CMA	01132
BESSEL	01124	SETINTAD	01131	PSQMP	01135
PSQMP6	01133	THIRD	01134	SIXTH	01140
KENNEDY	01136	NUMDERIV	01137	BESSEL3	01164
FBESSEL	01145	INTERPOL	01152	MUNICH	01227
EGRESS	01200	PARTIAL	01217	STDR1	01267
STOR2	01246	LINCDLN	01253	STDR3	01312
STOR4	01305	NDFLD1	01311	FIX1	01325
NOFLO2	01317	FIX2	01320	NOFLD3	01355
FIX3	01326	SUM	01353	MINUS	01366
NDFDURTH	01361	DIFF4ZFRD	01364	REMAINDER	01366

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PLANETRACK   FRACHTMAN*8/4/64

LABEL	LOC	LABEL	LOC	LABEL	LOC
CIVIL	01374	FLOTEST1	0140C	BCTHNEG1	01412
FLOTEST2	01422	BOTHNEG2	01434	FLDTEST3	01444
BOTHNEG3	01456	NEGBESS1	01466	NEGBESS2	01471
NEGBESS3	01474	NEGBESS4	01477	LEFRNDCFF	01502
MIKE	01507	ROUNOOFF	01512	MAX	01517
PLANRAD	01522	IOENT	01533	YRREMAIN	01534
WHOLEYEAR	01535	JULIANOAY	01536	IMPERIAL	01537
TAPEBLOCK	01540	SLOTBLOCK	01541	TAPESEARCH	01542
RAAD	01543	DECAO	01544	DISTAC	01545
RAOIFAD	01546	DECDIFAO	01547	DISTCIFAC	01550
SAIGON	01551	SAFE	01552	AEPHEM	01553
LASTEPHEM	03452	ASSSSS1111	03454	ASSSSS1112	03455
ASSSSS1113	03456	ASSSSS1114	03457	ID1CELCDR	6300D
IO2CELCOR	63001	RA	63002	CEC	63003
SRA	63004	SDEC	63005	RADIUS	63D06
RAOOT	63007	DECDOT	6301C	RADIUSDOT	63D11
SIDERTIME	63012	VIZRA1	63013	VIZDEC1	63014
VIZRA2	63015	VIZOEC2	63016	ID1RADCOR	63050
IO2RADCOR	63051	RANGE	63052	AZIM	63D53
ELeV	63054	SAZIM	63055	SELEV	63D56
CRANGE	63057	CAZIM	6306C	CELEV	63061
RANGEOOT	63062	TRUERANGE	63063	SINDRIENT	63064
COSORIENT	63065	SINAZEL	63066	CDSAZEL	63D7D
ACQAZIM	63071	ACQELEV	63075	FRAMESIZE	63101
RADIOMETER	63102	TIMEMODE	631D3	FIRSTELEV	63104
ASTRORA	63105	ASTRODEC	63106	ID1TIME	6313D
IO2TIME	63131	TRUETIME	63132	CELTIME	63133
SCELTIME	63134	CONVERTIME	63135	SRACTIME	63136
HOURMINUTE	63137	SECUNOS	6314C	DSECDNDS	63141
ACTUALTIME	63142	ESTSHIFTED	63143	GMTSHIFTEC	63144
GMTMODU24	63145	BLASTOFF	63146	YEARMCNTH	63147
DAY	63150	HOURREG	63151	MINREG	63152
FIRSTHRU	63153	DUMSECTTG	63154	ID1RECRD	6321D
IO2RECRD	63211	RECFILE	63212	ID1SYSPAK	6331D
IO2SYSPAR	63311	RADARMODE	63312	SYSTAT1	63313
SYSTAI2	63314	SYSTATD	63315	DELTATEE	63316
FREQUENCY	63317	LONGITUOE	6332D	GEDDETLAT	63321
GEOCENLAT	63322	EQUATOR	63323	PCLE	63324
AZIMOVER	63325	HEIGHT	63326	YRTRAN	63327
ZRTKAN	63330	SKIP	63331	AUCCNVER	63332
WFFREQ	63333	MAINSWITCH	63334	EXPNAME	63350
IO1ENTPNI	63410	IO2ENTPNT	63411	MCPGM	63412
INTER	63413	COGCN	63414	RECRC	63415
AOSCN	63416	AESCN	63417	CORCT	63420
DYDMP	63421	CHCCR	63422	PRLDG	63423
CELCOHPGM	63424	CATANALYZE	63425	INTERCOM	63426
ACQI	63427	RDMTR	6343C	CHPAR	63431
WFORD	63432	RDXXX	63433	PLANP	63434
TIMEP	63435	IO1RADIO	6344C	ID2RADID	63441
AZIMADD	63442	ELEVADD	63443	CCPPACC	63444
RANGEADD	63445	INAZIMADD	63446	INELEVACC	63447

SPURT OUTPUT NO. 212

FRACHTMAN-8/4/64

PLANETRACK					
LABEL	LOC	LABEL	LOC	LABEL	LOC
WFAOO	63450	IO3RADIO	63776	IO4RADIO	63777
AZIMOUT	64000	ID5RADIO	64776	IO6RADIO	64777
ELEVOUT	65000	ID7RADIO	65776	IO8RADIO	65777
DOPPOUT	66000	ID9RADIO	66776	IO1ORADIO	66777
RECAZIM	67000	ID11RADIO	67776	ID12RADIO	67777
RECELEV	70000	ID13RADIO	70775	ID14RADIO	70776
RANGEOUT	70777	MCPFILLER	71000	IO15RADIC	71776
IO16RADIO	71777	INTERAZIM	72000	IO17RADIO	72776
ID18RADIU	72777	INTERELEV	73000	IO19RADIU	73776
ID20RADIO	73777	INTEROOPP	74000	IO21RADIO	74776
ID22RADIO	74777	AZIMIN	75000	ID23RADIC	75776
ID24RADIO	75777	ELEVIN	76000	IO25RADIC	76775
ID26RADIU	76776	INTERRANGE	76777	IO1SYSENT	77576
ID2SYSENT	77577	SYSENTRIES	77600	IO1SYSNAM	77676
ID2SYSNAM	77677	SYSNAMFS	77700		

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2. Explanatory Supplement to the Astronomical Ephemeris and the American Ephemeris and Nautical Almanac (Her Majesty's Stationery Office, London, 1961).

3. R. Butler and E. Kerr, An Introduction to Numerical Methods (Sir Isaac Pitman and Sons, Ltd. , London).

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13. ABSTRACT

This report describes the procedure used by the Haystack Pointing computer program for obtaining the celestial coordinates of the planets at any time.

DD FORM 1473
1 JAN 64

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Program						
Computer						
Planet						
Pointing						
Time						
Input						
Output						

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